

## Athletes Need Zinc

Athletes who steer clear of beef and load up on carbohydrates to achieve peak performance may be missing the nutritional mark. The same could be true for wrestlers, gymnasts, and ballerinas who may eat sparingly to maintain a low body weight.

These groups may get only a fraction of the recommended intake of zinc, for which beef is the major source in the U.S. diet.

Trace elements such as iron and copper are known to play an integral role in the ability of body cells to generate energy, or do work. But few studies have looked at the effect of limiting zinc intake, says Henry C. Lukaski, who is at ARS' Grand Forks Human Nutrition Research Center in Grand Forks, North Dakota.

So he recruited 12 athletic men in their twenties to help him assess zinc's impact on the body's performance during exercise. They ate one diet containing 18 milligrams of zinc per day—more than the recommended amount—and another containing only one-fifth the recommended level (3 mg/day) for 9 weeks each.

Lukaski focused on a zinc-containing enzyme, carbonic anhydrase, in red blood cells. More than 20 years ago, scientists reported the enzyme was reduced during zinc deficiency. Carbonic anhydrase helps red blood cells pick up metabolic waste—carbon dioxide—and drops it off in the lungs to be exhaled.

This exchange helps maintain a proper chemical environment in muscle cells for muscle contraction and the energy production so necessary for an athlete's peak performance. "If this exchange is sluggish, the athlete pays the price," says Lukaski.

After each diet period, the men were tested on a cycle ergometer to measure their peak work capacity. Not surprisingly, they had significant drops in peak oxygen uptake and peak carbon dioxide output after the low-zinc diet. Their respiratory exchange ratio dropped as well, indicating energy production during peak exercise was not up to snuff.

The low-zinc diet also depressed these measurements when the men cycled at 75 percent of peak capacity for 45 minutes. Lukaski found that the enzyme's activity was significantly lower after the low-zinc diet. He is now using rats to study other zinc-containing enzymes thought to be involved in energy expenditure.—By **Judy McBride**, ARS.

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## FANS Makes Measuring Air Movement a Breeze

Ventilation fans are critical in animal barns for delivering fresh air and removing heat, moisture, and dust. But measuring a fan's performance in a barn has been difficult.

"Traditional techniques have been cumbersome, inaccurate by 8 to 10 percent, and slow—taking 30 to 45 minutes," says animal physiologist J. David May, who is with the Agricultural Research Service.

May, agricultural engineer John D. Simmons, and animal scientist Berry D. Lott at the ARS Poultry Research Unit in Mississippi State, Mississippi, overcame these problems. They designed and built FANS, short for fan assessment numeration system.

FANS quickly and accurately measures air output of large, in-place ventilation fans. The system consists of a portable anemometer—an instrument developed to measure wind-speed—plus a computer and software to record and analyze measurements.

"FANS helps solve the thorny technical problem of measuring the output of in-place ventilation fans in animal barns," says May. "Such measurements had been theoretically possible but not technically feasible until now. The anemometer can measure volumetric flow rates with 99-percent accuracy in less than 4 minutes."

The anemometer has been used in ARS studies on fan components including shutters, exhaust cones, belt guards, and propellers. Future studies will test fan output on light baffles, fan belt condition, dust, and static pressure.

The scientists assembled and calibrated the anemometer in cooperation with Thomas E. Hannigan, who is at the Aerospace Engineering Department at Mississippi State University. A major fan manufacturer, Hired Hand Manufacturing Co., of Bremen, Alabama, validated FANS at its flow laboratory.

While primarily a research tool, FANS has many useful applications. For example, it saved a major egg company more than \$200,000. To protect employees from possible hand injuries, the company installed belt guards on 1,100 fans in 115 poultry houses. FANS showed that ventilation remained adequate with the guards installed, so the company didn't have to buy additional fans.

FANS can also pinpoint the best location for ventilation fans. It showed that fans placed at the end of a long poultry house are more efficient than those along the side walls at the end.—By **Hank Becker**, ARS.

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